SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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DURABILITY PERFORMANCE OF ULTRA-HIGH PERFOMANCE CONCRETE (UHPC) INCORPORATING WASTE RUBBER POWDER

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ABSTRAK

Pelupusan sisa pepejal daripada bahan buangan oleh-produk adalah salah satu isu alam sekitar yang utama pada masa kini seperti tayar ada. Sebelum ini, penggunaan tayar yang dikitar semula sebagai pengganti agregat dalam pengeluaran konkrit konvensional telah diterokai. Sebagai perbandingan, Ultra High Perfomance Concrete (UHPC) adalah memperkenalkan dalam kajian sekarang ini. Pada masa kini, UHPC telah menjadi terkenal kerana ia kekuatan tinggi yang boleh dicapai sehingga 100 MPa. Selain itu, UHPC telah dihasilkan dengan menggunakan nisbah air simen yang rendah dan menggantikan OPC dengan 10% silika wasap meningkat dengan ketara kebolehkerjaan, kekuatan dan ketahanan. Oleh itu, idea untuk menggantikan jumlah agregat halus dengan tayar sisa serbuk getah iaitu micronized (MRP) dalam pengeluaran UHPC telah dikaji. Penggantian peringkat MRP terdiri daripada 5%, 10% dan 15% daripada berat agregat halus digunakan. Dalam kajian ini, kesan penggunaan peratusan yang berbeza MRP kepada sifat-sifat UHPC tertakluk kepada rintangan ketahanan dikaji. Untuk ujian ketahanan, spesimen UHPC telah direndam di dalam larutan dan magnesium sulfat asid hidroklorik untuk 14, 28 dan 60 hari pendedahan. Selepas rendam, spesimen terdedah telah diuji untuk menentukan kekuatan dan kehilangan jisim mereka masing-masing. Dari hasil, UHPC dengan WRP telah sangat menentang terhadap serangan asid dan sulfat. Kajian ini telah membuktikan getah di UHPC telah secara drastik mengurangkan kekuatan mampatan tetapi masih lebih kuat daripada konkrit biasa. Ia berharap, kajian ini boleh menjadi berguna untuk inovasi masa depan dengan penggunaan tayar sisa dalam industri pembinaan.

ABSTRACT

Solid waste disposal from waste by-products are one of the major environmental issue nowadays such as tires disposal. Previously, the utilization of recycled tires as aggregate replacement in conventional concrete production have been explored. In comparison, ultra-high performance concrete (UHPC) is introduce in this present study. Nowadays, UHPC has become famous due to it high strength that can achieved up to 100 MPa. Besides, UHPC was produced by using low water cement ratio and replacing the OPC with 10% silica fume improved significantly its workability, strength and durability. Therefore, an idea to replace the amount of fine aggregate with waste tires namely micronized rubber powder (MRP) in UHPC production was studied. The levels replacement of MRP comprises of 5%, 10% and 15% from the weight of fine aggregate used. In this present study, the effect of using different percentage of MRP to the UHPC properties subjected to durability resistance was investigated. For durability test, the UHPC specimens were immersed in hydrochloric acid solution and magnesium sulphate solution for 14, 28 and 60 days of exposure. After immersion, the exposed specimens were tested to determine the strength and its mass loss respectively. From the result, UHPC with WRP were highly resist towards acid and sulphate attack. This study had proved the rubber in UHPC had drastically reduce in compressive strength but still stronger than ordinary concrete. It is hope that, this study could be useful for future innovation with the use of waste rubber in construction industry.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Waste rubber tire have become environmental problem due to its non-biodegradable characteristic. Until now the way to recycle and disposed them is a challenge. Tires are made of complex mixtures which rubber, black carbon, steel cord and other organic compound. The increasing of waste rubber tire gradually increase every year. There are about 1.5 billion waste tires are generated annually. With statistic data, in 2002 there was 80 million tires were created and 120 million in 2010 which makes 12% of enlargement (Jinhua et al., 2015). This upsurge have become have become major environmental problems. There are various method of recycling waste tires such as combustion, retreating or reusing the tire and there are pros and cons of using these methods.

Previous research, several researchers have been replaced aggregate partially with waste rubber tire in concrete. High Performance Concrete (HPC) with rubber waste have good resistance towards acid attack but could lead to serious compressive strength loss (Azevedo et al., 2012). Concrete with rubber as partial replacement has high sound insulation with high ductility and toughness but lower compressive and tensile strength (Siddique et al. 2008) It is possible to use of rubber waste up to 15% and still maintain a low capillary water absorption without affect the resistance of

concrete towards sulphuric acid attack. But to maintain the compression strength, the partial replacement of total volume must not higher that 5% (Azevedo et al. 2012). Rubber with 5% to 15% of fine aggregate also could improve the resistance to sulphate attack (Jinhua et al., 2015). It is found that crump rubber in concrete have loss bonding ability which affect the strength of the concrete (Selvakumar et al., 2015).

Recently, the researcher had developed a new high durable concrete that surpass HPC strength which is known as Ultra High Performance Concrete (HPC). UHPC also known as reactive powder concrete (RPC), is a ductile material formulated by combining OPC, silica fume, quartz flour, fine silica sand, high-range water reducer, water, and steel or organic fibres. The compressive strengths of UHPC can be range from 100 MPa to 200 MPa and flexural strengths could up to 50 MPa (Sudha et al., 2014). Since UHPC has high compressive strength and excellent durability properties, it is possible to produce lighter products and longer life with thinner sections (Rahman et al., 2015).

Overall, UHPC have many advantages in term of construction time, aesthetics value, superior durability, and permeability against corrosion, abrasion and impact to reduced maintenance and a longer life span for the structure (Azevedo et al., 2012). In this study, the durability and compressive strength of UHPC with finer waste tire which is micronized rubber powder (MRP) as fine aggregate replacement will be investigated.

1.2 Problem Statement

There are huge environmental impact of concrete and some effect are very harmful and some interrupt the sustainability. Aggregate and cement are the primary ingredient in manufacturing concrete. These natural resources are highly demanded due to many construction project nowadays that lead to massive exploitation of natural resources and pollution. Nowadays, the continuous extraction of natural aggregate, fine aggregate, and gravel which taken from water bodies such as river beds and lake have led to erosion which eventually leads to landslide and flood. Afterwards, there will be less rainwater filtration and could cause contamination of water for human

consumption. Besides, the production of cement emits a huge amount of carbon dioxide which is a one of the cause of greenhouse and acid rain pollution.

The dumping of tire also one of the huge environmental global issue. Manufacturing tires are gradually increase every year due to its high demand for vehicle such as jet, airplane, and others. The problems are these kind of vehicle need to change the tire about one times a year depend on the usage. When the number of people increase, the number of vehicle also increase and increase the number of dumping tires every year. Even though there are various method to recycle waste tires, these user increment will slow down the effectiveness to dispose waste tires. The method to dispose waste tire need to be improvise and increased in order to exceed the number of waste tire produced.

1.3 Objective of Study

The objectives of study are:

i. To compare the compressive strength using different percentage of rubber powder
ii. To compare the percentage of weight loss after immersed in sulphuric acid and magnesium sulphate
iii. To compare the percentage of strength loss after immersed in sulphuric acid and magnesium sulphate

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